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OLD CROSSTIES--A POTENTIAL ENERGY SOURCE FOR WOOD PRESERVING PLANTS

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A SOLUTION TO A PROBLEM

Most railroad executives look upon old tie disposal as a nasty problem. After open burning was banned, many railroads allowed old ties to accumulate along the right-of-way. But in a few years, rail officials recognized that this do-nothing practice was detrimental. The old ties or tie butts caused fire and safety hazards. They clogged drainages. And they spoiled right-of-way appearance thereby giving environmental critics a chance to complain about pollution.

The most practical solution to this problem would be to find suitable uses for the old ties or tie butts. Obviously, the landscape market offers an outlet for many full-length ties. Our marketing laboratory at Princeton, West Virginia, has not yet quantified the annual demand for landscape ties. However, a critical analysis of old tie condition indicated that only half of the specimens would make good landscape ties. Other potential uses were investigated: pallet parts, mine crib blocks, and reassembled ties. None of these outlets proved feasible. Industrial fuel seemed to be the only product with universal potential.

Wood preserving plants should have a direct interest in this solution to the railroads' tie disposal problem. Old ties could be processed and burned to provide all treating plant steam and heat requirements. Furthermore, wood preserving plants could serve as processing sites for all old ties removed. Material not needed for plant energy could be sold back to the railroads to heat car shops or other facilities. Or the processed fuel could be marketed at other manufacturing plants that have fuel shortages and higher fuel prices.

Economics will be the governing factor influencing your decision to accept or reject this proposal. We will cover that element in depth later in this article. However, you should not overlook an unexpected benefit--national acclaim. Energy shortages and fuel prices receive almost daily attention in the news media. When our lawmakers and news commentators learn that wood tie preserving plants can conserve the annual equivalent of 710,000 barrels of oil by burning old ties, your industry will likely get some appreciative accolades. But you will not get this credit or the ties free. You will need to make investments in plant equipment that will allow you to process and burn this tie fuel efficiently and cleanly.

MATERIALS HANDLING

In 1974, about 19 million ties were replaced (4). However, the marketing committee of the Railway Tie Association (5) projects that authorized purchases in 1976 could reach 26 million ties. Since many railroads cut ties into three pieces during removal, the handling of more than 50 million butts and ties constitutes an enormous problem. Retrieval of old ties will be more difficult and expensive than placement of new ties. The number of pieces to handle are more than double the number of new replacements. And special equipment for all phases of the tie fuel venture have not had sufficient field testing.

TIE PICKUP AND TRANSPORT

You wood preserving specialists and treating plant operators may not care about the railroad's problem of old tie pickup. But, if these old ties are going to fuel your boilers, you have a direct interest--money. The easier the ties can be picked up, the cheaper they can be delivered.

Last year, we began some tests designed to quantify the time and cost of picking up tie butts. These preliminary studies were run in cooperation with a major railroad using a self-propelled rail clamshell with fore and aft coupled gondolas. Two replacement sites were evaluated. With heavy replacements of up to 900 ties per mile, the crane loaded one car per operating hour. About 980 tie butts weighing nearly 30 tons were heaped in a car. With light replacements of 350 ties per mile, it took 1-1/2 hours to load 915 tie butts in a gondola. Both the wider spacing of tie butt piles and delays from passing trains were responsible for the longer loading times.

Next, we decided to evaluate a hydraulic knuckle-boom grapple used in the logging industry. These tests were run on two carloads of tie butts delivered to a nearby siding. Results were far below our expectations. The crane operator spent 2 hours and 20 minutes unloading a car and 1 hour and 40 minutes reloading it. This loader operated at about the same cycle speed as the railroad clamshell. However, the log grapple could only grasp about 4 to 6 tie butts because of the jackstrawed pieces in both the cars and the pile. When tie butts were arranged in oriented stacks, loading time was considerably reduced. Loading performance jumped from 8 to 13 pieces per minute for piles of 12 tie butts and from 9 to 11 pieces per minute for piles of 20 tie butts.

Although the hydraulic grapple did a cleaner job of loading and unloading than the railroad clamshell, its rate of performance was substandard. For this reason, we recognized the need for a high-speed machine that could load either ties or butts while operating from the track. Our operating concepts were presented to the Lucky Manufacturing Company[1/] who prepared a set of working drawings. The engineering design seemed acceptable to rail officials so they arranged for the construction of a prototype and production model.

The Lucky Loader is a modified hydraulic crane that rides on the top of standard gondolas--crossing from car to car as they are loaded. It has two big advantages: (1) it eliminates switching cars loaded fore and aft of a rail-mounted crane, and (2) it serves as the distributing unit for black ties ahead of the tie gangs.

1/ The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

We expect the Lucky Loader will have the capability of picking up 25 tons of tie butts (one car) per operating hour. Used with a special work train, this machine should easily load 8 cars per 12-hour day. This performance includes anticipated delay time for travel to and from the site plus downtime for passing trains. Delay figures were taken from tie gang records showing sources of delay. In heavy tonnage, single track territory, daily tie butt pickup might only amount to 150 tons or 6 cars. Forthcoming tests will establish reasonable performance standards.

TIE PROCESSING LOCATION

Crossties represent one of the major commodities impregnated by many wood preserving plants. Treated ties are usually shipped in assigned gondolas or special tie cars. So most of these same cars return empty to the originating plant. Materials managers suggested that the old ties should be loaded into the empty cars and returned to the treating plant for conversion into industrial fuel. This recommendation makes sense from the standpoint of car use, tie disposal, market potential, and energy conservation.

If the use of old ties for treating plant fuel seems feasible, two processing options are available. The old ties can be hogged as they are picked up. Or, they can be picked up and hauled to a central processing facility.

We think centralized processing has several advantages. Heavy grinding equipment can be mounted on sturdy foundations. Continuous machine operation can be expected. High hourly production rates can be achieved. Supplemental blowers and piping required by the portable system can be eliminated. Dependable electric power can be used. One man can operate the unloading crane, and another man can tend the grinder and hogged fuel conveyors. Stringent safety standards can be met.

UNLOADING AND STORAGE

Let us assume that a treating plant considers the option of using old railroad ties for all its steam needs. Is there enough yard space available to stockpile full-length ties, butts, or fragments? Do extra tracks and roads need to be installed? Should the plant manager limit the quantity of old ties delivered? What type of unloading equipment should be used? Will ties be hogged as they are unloaded or stored and later burned as butts? Are anti-pollution facilities required? Should storage silos be built for hogged fuel?

Answers to the above questions relating to unloading and storage must be given during the planning arrangements. No two situations between railroads and treating plants will likely be similar. So rather than explore all options, we have designated a specific set of procedures which we think might be generally acceptable.

Incoming cars of old ties should be unloaded with a pedestal mounted crane. The hydraulic crane should be equipped with a maneuverable bucket-type grapple that can reach all sections of a spotted car. If the crane has a 35-foot reach and is mounted on a 20-foot pedestal, about 350 tons of tie butts can be stored in a 20-foot high pile. This storage capacity assumes that one-third of the area is unavailable because of service tracks. For a 30-foot high pile under similar restrictions, tie butt storage capacity would be about 700 tons: a 2-week's fuel supply. The variation in storage volume depends upon the presence or absence of a restraining fence on the storage perimeter and the angle of repose for piled butts.

Storage in butt form is preferable to storage as hogged chips. Butts take less space per unit of weight. Cars can be unloaded quicker than if all the old ties had to be immediately fed into the shredder. Moisture absorption is minimal in tie butt form. Leachate from stored butts would cause less potential pollution in precipitation runoff. Danger of accidental ignition would be minimized.

TIE DISINTEGRATION

Most combustion units suitable for wood incineration require particles no longer than 4 inches. Fragments less than 1 inch are most desirable because they do not clog conveyors and they burn uniformly with less smoke.

A number of heavy duty swing hammer shredders are presently available that would break up old crossties. We know of two kinds of shredders that have been used to disintegrate old ties experimentally. Pettibone's Hammermill Bulldog[2/] shredder operates with a horizontal rotor. Our tests indicated that their Model 6060 could produce at least 20 tons of fragments per hour without any delay from foreign objects. From our shaker screen analysis, the distribution of fragment sizes were:

40 percent retained on a 1-inch square mesh

25 percent passing a 1-inch mesh but retained on 1/2-inch mesh

35 percent passing through a 1/2-inch mesh.

Secondary grinding of these fragments with a Montgomery Hog[3/] produced ideal fuel particles less than 1/4-inch thick and 1-inch long.

2/ Ibid.

3/ Ibid.

Old crossties were also processed with Carborandum's Eidal grinder.[4/] This unit uses a vertical rotor with gear-type crushing heads mounted at the ends of rotating arms. Material moves down the cone-shaped body by gravity. Grinding rate and particle size can be varied by adjusting the outfeed choke. This unit can also process 20 tons of tie butts per hour. It requires less horsepower and rotates more slowly than the other shredder tested. Particles had a similar appearance to those produced by the Hammermill's[5/] shredder. Screenings showed 99 percent of the output passed a 2-inch screen and 88 percent passed through a 1-inch screen.

Many aspects of materials handling and tie processing have been purposely omitted from this paper. Railroads and wood preservers interested in the necessary details of tie fuel processing and handling should consult the test department of the AAR or our marketing laboratory at Princeton. In fact, the specifics in the following sections of this paper dealing with heat yields, combustion, and economics are also available from these two organizations.

4/ Ibid.

5/ Ibid.

HEAT YIELDS

How much heat can you expect from burning old crossties? To answer that question, we built and equipped a small laboratory specifically designed to determine the heat of combustion. More than 250 crosstie samples from mid-Atlantic Coastal and Mountain regions were analyzed in the oxygen bomb calorimeter.

Tests run in our laboratory were based on chips from holes bored at specific locations on upper and lower faces of sample ties (fig. 1). Two heat yield analyses were made for each sample. Heat of combustion was first determined for the fresh chips--later for oven-dry chips.

For fresh tie chips, heat outputs ranged widely depending upon sample location within the tie. In fact, differences in heat of combustion within a tie were often greater than the heat outputs between ties of similar species, age, and service territory. These fluctuations can be attributed primarily to one factor: moisture. Crosstie ends usually had the highest heat outputs, tie plate areas had the lowest (fig. 2). Plotted data show a rather close negative correlation between moisture and Btu output. The heat of combustion from oven-dry samples showed little variation across the face of the sample ties.

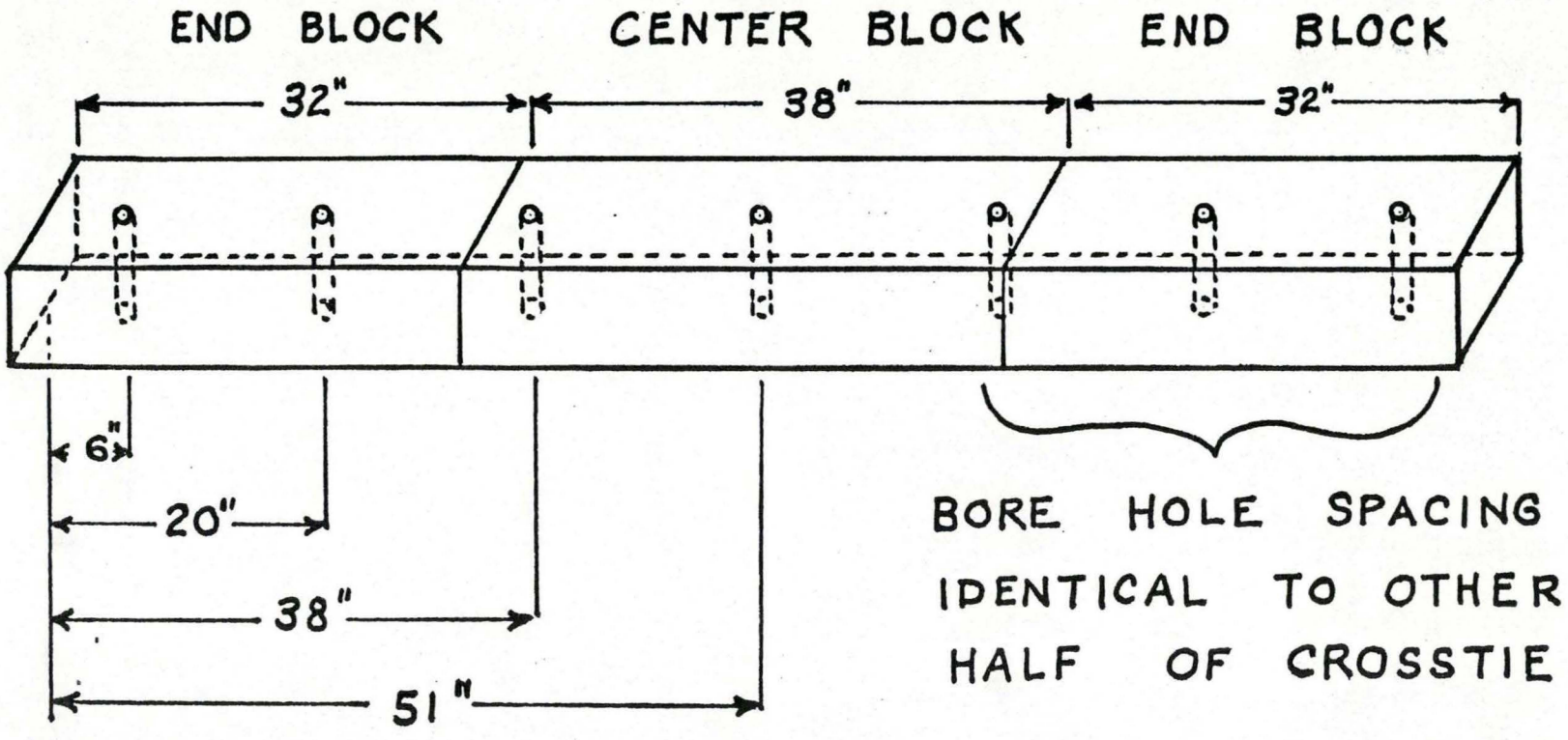

Figure 1.--Location of sample bore holes for analyzing heat of combustion and moisture content in old crossties

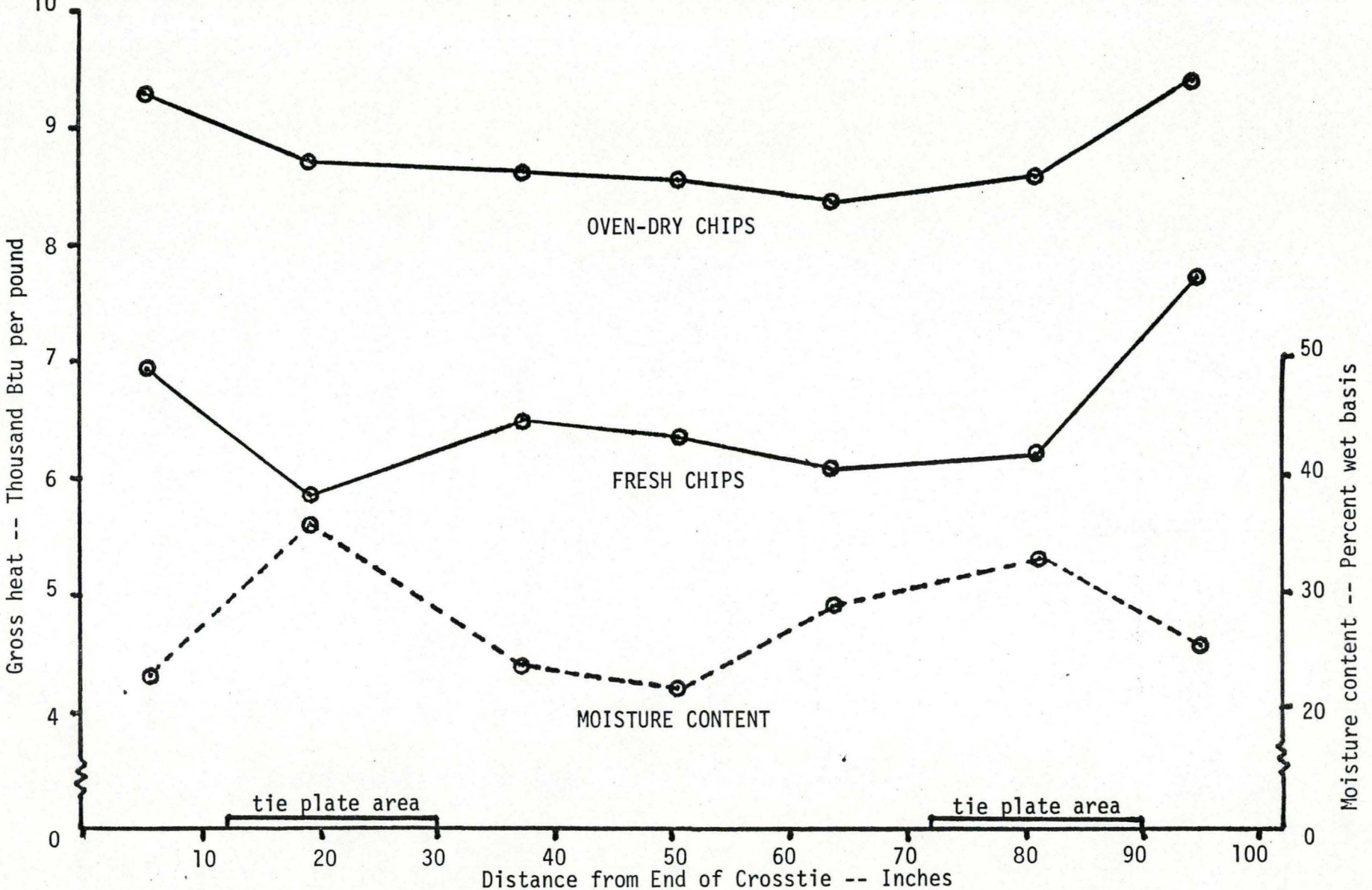

Figure 2.--Heat of combustion for fresh and oven-dry chips sampled at various locations in red oak crosstie number 28

Most of our research on crosstie heat yields was conducted on oak ties removed from mainline and branchline tracks in the mid-Atlantic Region. Some mixed hardwoods were also evaluated. Overall results of these tests are shown in the following tabulation:

Chip condition	Moisture content (percent, wet basis)	Heat yield (Btu/pound)
Fresh (as bored)	23.7*	6,734
Oven-dry	0	8,637

* Although chips were kept in sealed vials, some moisture loss likely accrued during field collection.

These values represent averages from 128 separate borings taken from 34 different crossties. Two calorimeter burns were made for each bore hole sample to get fresh and oven-dry heat values. Ties selected for sampling represented conditions found on mainline, branchline, siding, and yard tracks. Tie service life ranged from 20 to 50 years. Time since replacement covered a span from 1 to 22 months.

In addition to the mid-Atlantic hardwoods, we analyzed about 50 vials of sample chips representing hardwood and softwood ties in other territories. These combustion studies were made by A. J. Dolby, environmental engineer of the Illinois Central Gulf Railroad (2). Both green and oven-dry heat outputs were developed for seven borings from each of five Santa Fe ties removed from Southern California service. Heat yields were computed for seven borings from each of three hardwood ties removed from Mississippi tracks. Specific results have been published in Dolby's AAR Test Report (2). In general, the Mississippi hardwoods had slightly lower heat yields than mid-Atlantic specimens. Western ties had noticeably higher heat yields due to lower moisture contents and to the resins present in softwood species.

For a given species, the heat of combustion from oven-dry samples showed little variation across the face of the ties. Values ranged around arithmetic means of 8,400 Btu/pound for oak, 8,600 Btu/pound for mixed hardwoods, and 10,000 Btu/pound for softwoods. None of these figures differ greatly from previously recorded heat yields for nontreated wood (3). Thus, it is apparent that residual preservatives had little influence on heat yields.

You wood treating specialists might be interested in the amount of residual preservative in old crossties. Two independent laboratories reported that creosote remaining in old ties ranged from 1.8 to 3.9 percent of crosstie weight. The average residual creosote amounted to 3 percent of old tie weight (2). Using an average weight of 195 pounds, old crossties would then contain about 5.8 pounds of preservative.

We did not make an evaluation of ash content, although we computed the influence of noncombustibles on the heat yields from some of our early samples. Other laboratories reported an ash content of less than 5 percent by weight for most tie fuel samples analyzed (2). Where hogged tie samples were contaminated with excessive ballast and dirt during collection and processing, the ash content soared to 13 percent.

COMBUSTION TESTS

Restrictions on trackside burning of old crossties indicate that some authorities think air pollution levels are unacceptable. So the successful use of discarded ties for industrial fuel will depend upon air quality standards as well as on the cost or savings per million Btu.

In September 1974, we initiated a preliminary test of burning hogged tie fragments in a York-Shipley[6/] fluid bed incinerator. Fragments from two groups of ties were burned consecutively under identical operating conditions. Group 1 consisted of tie destroyer particles from 25 to 30 year old mainline ties. Group 2 was comprised of fragments from branchline ties with a 40 to 50 year service life.

Results of this small-scale test were exceptionally good. Complete incineration of combustibles was achieved--either on the sandbed or in suspension. Stack emissions were invisible. Combustion chamber temperatures remained nearly constant at 2100°F. Feed mechanisms did not clog. And boiler outputs were completely satisfactory at about 4 million Btu per hour, with the older ties showing a slighly higher evaporation rate and steam yield.

6/ Ibid.

After the trials were completed, the company issued a satisfactory report. Encouraged by this preliminary trial, Mr. Coxey of the AAR Test Department arranged for a day-long test using the same York-Shipley incinerator boiler package. The purpose of this investigation was to see if the combustion of old ties met EPA stack emission standards. Tie butts were supplied by N&W, hogged by Penn Central, and trucked to the York-Shipley facility. The Roy Weston Company[7/] was engaged to conduct the performance evaluation using approved EPA procedures.

Results were mixed. Old ties burned in the York-Shipley converter passed all EPA tests except one: the amount of fly ash particulate (2). Sulfur dioxide was 6-1/2 times lower than EPA limits. Nitrous oxides were only one-fourth of the allowable maximum. Hydrocarbons were less than one part per million. And surprisingly, opacity of the stack exhaust was only one-fourth of the EPA allowable output.

7/ Ibid.

Although you could not see the stack emissions, the catch of fly ash amounted to .318 grains dry standard cubic foot. This volume exceeded EPA standards by a factor 4. York-Shipley engineers were confident they could meet particulate emission standards. They replaced the original fly ash collector with a Roto-Clone[8/] air filter. Then they conducted another EPA stack emission test. The particulate catch of 0.064 grains per SCF dry, fell below the EPA standard of .080 grains per SCF dry. So this combustion package has met all federal stack emission standards.

Obviously, there are other techniques and equipment that can be used to burn old crossties. One of the more promising units with a proven service record is made by Consumat Systems, Inc.[9/] The Consumat incinerator can burn tie butts or full-length ties. No shredding or size reduction is needed.

Consumat units were originally built to dispose of a variety of municipal and industrial wastes. They operate on the controlled air concept. Waste is heated in the lower chamber where combustibles are converted into gas. Smoke and gas are burned in the upper chamber to eliminate noxious emissions and particulates from the exhaust. Small quantities of auxiliary fuel are constantly required to keep the burner functioning.

8/ Ibid.

9/ Ibid.

Energy packages are available for Consumat burners. Exhaust gases are circulated through a heat exchanger for steam production. When steam demands drop, excess heat can be dumped through the main stack. An impressive array of supplemental equipment has been built into the unit to operate the soot blowers, stack drafts, and water feed systems.

Using a Consumat installation at Siloam Springs, Arkansas, a test of burning unshredded tie butts was conducted by company personnel, the U.S. Recycle Corporation[10/] and Koppers Company.[11/] Results were entirely satisfactory from the standpoint of complete combustion, ash removal, and visible stack emissions. Records from the test indicate that the largest Consumat model can burn about 1 ton of crossties per hour and convert the recoverable heat into 7,000 pounds of steam. Therefore, four combustion-energy packages would be needed to supply a good sized treating plant.

It would be inappropriate for us to compare the differences between the Consumat and York-Shipley combustion systems. I am convinced that both will ably perform the task of converting old ties into industrial steam. The two systems may not be of comparable operating efficiency. Therefore, potential users should carefully consider the following factors: capital investment, fuel preparation requirements, steam output and demand modulation, automation of fuel delivery systems and boiler controls, auxiliary power and fuel costs, and handling of noncombustibles.

10/ Ibid.

11/ Ibid.

Treating plants that burn coal for steam production have another option. Mixtures of hogged ties and coal can be used--provided the components of the furnace permit the compatible combustion of both fuels. If tie particle size presents a combustion problem, screening and regrinding may solve it. Or, if visible stack emissions prohibit the use of such fuel mixtures, adjustment of furnace drafts or the installation of precipitators may eliminate the difficulty.

We have not burned mixtures of hogged ties and coal. Yet, we know that papermills mix bark and coal for their horsepower requirements. And we also know that some electric power companies have been successfully burning waste along with coal. Of course, these large utilities have the sophisticated equipment needed for pulverizing fuel and precipitating stack particulates. However, prices paid for the wood waste barely offset transportation costs.

Another option for coal burning treating plants would be to convert present facilities to burn old ties exclusively. Hogged wood waste has been burned in the following type furnaces: dutch oven, fuel cell, spreader stoker, and inclined grate (1). However, some change in coal furnace components and operation would likely be needed. One of the major changes would be air pollution control equipment. Old ties can be expected to have a high proportion of fly ash. These particles will consist of unburned carbon or char plus sand and dirt. Although mechanical collection of fly ash appears reasonable, two-stage particulate removal by cyclones and wet scrubbers might be better.

ECONOMIC CONSIDERATIONS

Obviously, treating plant operators will not change from existing fuels to hogged crossties unless the cost of steam from this alternate source is cheaper. True, old ties should not be influenced by rapid changes in supply or price like other fuels. But neither the assured supply nor the stable price may be the deciding factor in fuel conversion. It will likely be the capital costs associated with a tie-burning plant.

A switch from traditional fuels to old ties will require a large capital investment. Here are some of the major components of a new tie combustion facility and their estimated costs:

1.	Treating plant additions		
a.*	Fluid bed incinerator with high pressure steam boilers of 39,000 pounds per hour maximum output plus electrical controls and installation	=	$400,000
b.	Boiler water feed system	=	25,000
c.	Piping, insulation, and valve interlocks	=	20,000
d.	Pedestal-mounted hydraulic crane with 35-foot boom and grapple	=	50,000
e.*	Heavy-duty shredder capable of processing 20 tons of tie butts per hour	=	100,000
f.*	Conveyors for shredded ties	=	25,000
g.	New railroad track and switches	=	20,000
h.	Roads and site preparation	=	35,000
i.	Electric gas and water distribution systems	=	20,000
j.	Fire protection system	=	25,000
k.	Foundations	=	90,000
l.	Miscellaneous and contingency	=	40,000
	TOTAL ESTIMATED TREATING PLANT INVESTMENT		$850,000

*Note: York-Shipley incinerator-boiler and supplemental equipment used in this example because firm costs of Consumat System not yet available.

2. Railroad additions and betterment

a. Three special car top loaders for old and new ties	=	$100,000
b. 300 renovated gondolas - assigned for tie loading	=	300,000
TOTAL ESTIMATED RAILROAD INVESTMENT		$400,000

You may be dismayed by this $1-1/4 million estimated investment just to burn old ties. But take a look at the projected operating expenses on a ton basis. See if they don't look reasonable. Perhaps the cost of tie disposal or for treating plant fuel may be lower than your present costs.

OLD TIE PICKUP AND DELIVERY COSTS

Consider a representative case for a railroad that plans to replace 800,000 ties annually. All these new ties are supplied by one centrally located treating plant. Assuming that all the old ties will be returned to the same treating plant, 76,000 tons of tie butts will be sent back.

Assume that railroad executives have decided to provide two specially equipped work trains and a car fleet to handle black tie placement and the return of the old butts. Preliminary studies indicate that each special train can distribute some new ties and pick up about 6 cars of butts or 150 tons per day. So for 250 work-days, each train can pick up and short-haul 38,000 tons of butts.

Accounting department figures show that the cost of pickup and delivery for tie butts amounts to $12.80 per ton. A cost of $10.20 per ton has been assigned for tie butt pickup and transport, whereas a cost of $2.60 per ton has been allocated for car use and terminal charges. These figures are based on the premise that each special work train with a five-man crew costs $980 per 12-hour day.

Assume also that top railroad management had previously decided to clean up the right-of-way. They recognized that the accumulations of old tie butts could no longer be tolerated for the reasons cited at the beginning of this paper. Some butts were loaded with clamshell grapples and hauled hundreds of miles to dumps or strip mine landfills. Other ties were buried along the right-of-way with bulldozers. Where permissible, small piles of butts were burned. The average cost of this cleanup was about $18 per ton.

If you compare the cost of right-of-way cleanup with the cost of old tie delivery to the treating plant, you see that the later proposal saves about $5.20 per ton. Originally, we had hoped that railroads would actually make a profit from the sale of old ties for fuel. However, our expectations were too rosy. At best, we can expect railroads to minimize their losses. The degree of savings will depend more upon the ability of the railroads to consume tie fuel in company boilers than upon the sale of old ties to treating plants. Sales to other industries will be marginally profitable.

TREATING PLANT, HANDLING, PROCESSING, AND COMBUSTION COSTS

Once the tie butts have been delivered to the treating plant, railroad responsibilities end temporarily. The treating plant must assume the functions of unloading, storing, shredding, and burning the tie fuel. Obviously, they would want to perform these tasks with their own equipment and personnel. Otherwise, there would be difficult labor and accounting problems if some of the functions were shared.

Take a look at treating plant costs. The following figures represent overall unit expenses for the major operating functions performed. These estimates include a 10-year depreciation of capital improvements, repairs and maintenance, supplies and power, insurance, and labor. All cost functions except combustion are based on the annual volume of 76,000 tons. Unloading, shredding, and handling costs are based on two 8-hour shifts for 250 days per year. Combustion costs are based on an annual consumption of 11,500 tons burned on a 24-hour day for 250 days per year.

1. Delivered tie fuel costs
   a. Volume delivered: 76,000 tons
   b. Volume purchased from railroad: 11,500 tons
   c. Cost per ton of purchased fuel: $ 6.00
2. Unloading, grinding, and handling costs
   a. Capital investment for crane, shredder, conveyors, tracks, roads, site preparation, power distribution system, fire protection, and foundations: $345,000
   b. Average annual cash expense: $130,000
   c. Tie units handled: 76,000 tons
   d. Cost per ton: $ 1.75

3. Combustion costs

   a. Capital investment of $465,000 for incinerator-boiler package, foundations, water feed system, and piping

   b. Average annual cash expense: $137,825

   c. Annual units burned to provide daily boiler input of 600 million Btu: 11,500 tons

   d. Combustion cost per ton $ 4.23

4. Per ton cost of tie fuel burned $11.98

Now, let's compare the cost of using tie fuel with the costs of using traditional fossil fuels. And let's give existing fuels every advantage. Assume they are available in unlimited quantities. And also assume that the existing boilers have been completely paid off and cost nothing to operate. For equivalent heat outputs, here are the dollar values of traditional fuels if tie fuel costs $11.98 per ton:

Natural gas ---- $0.93 per MCF
No. 2 fuel oil ---- $0.137 per gallon
Bituminous coal ---- $27.31 per ton (6)

Look at the present unit fuel costs for your treating plant. Can you buy and use gas, oil, or coal at the above prices? If so, continue to use them--a shift to tie fuel would be unwise. But if you spend $35 for every ton of coal burned, you could save $3.37 for every ton of tie fuel consumed as a replacement. If you burn natural gas costing $1.69 per MCF on a confirmed supply basis, you could save $9.89 for every ton of ties used as a replacement fuel. And, if your fuel oil costs about $0.35 per gallon, every ton of tie fuel burned as a substitute would save you $18.57.

AN EXAMPLE OF PROFITS AND LOSSES

Let us consider a hypothetical but reasonable example of substituting old ties for traditional fuel at a tie treating plant. Let us also assume that quantities of old ties not used for treating plant steam will be processed for use in existing railroad steam plants.

[THE RAILROAD]

1.	Disposal costs for 800,000 ties: 76,000 tons @ $18 per ton	= $1,368,000
2.	Alternative delivery of all old ties to treating plant: 76,000 tons @ $12.80 per ton	$ 972,800
3.	Potential savings from delivery to treating plant versus traditional disposal:	$ 395,200
4.	Sale of 11,500 tons of tie butts to treating plant for fuel @ $6 per ton	$ 69,000
5.	Subtotal of apparent savings and income	$ 464,200
6.	Cost to railroad for custom grinding and reloading of excess tie fuel:	
	a. Unloading and grinding @ $1.75 per ton	
	b. Reloading cars or trucks @ $0.25 per ton	
	c. Treating plant margin for profit and risk @ $1 per ton	
	Cost of custom processing 64,500 tons @ $3 per ton	$ 193,500

7.	Cost of transporting tie fuel to nearby railroad steam plant:	
	64,500 tons @ $3 per ton	$ 193,500
8.	Total tie fuel processing and hauling expense to railroad boilers:	$ 387,000
9.	Apparent residual savings before using tie fuel: $464,200 - $387,000	$ 77,200
10.	Substitution of tie fuel for coal in railroad boilers:	
	a. Replacement of 28,289 tons of coal with 64,500 tons of tie fuel:	
	b. Value of coal replaced: 28,289 tons at $35 per ton	$ 990,115
11.	Total net railroad savings from treating plant and railroad use of tie fuel:	
	$990,115 + $77,200	[$1,067,315]
12.	Net tie disposal costs:	
	$972,800 + $387,000 - $69,000 - $990,115	$ 300,685
	Per ton	$ 3.96
	Per tie	$ 0.38

[THE TREATING PLANT]

1. Current cost of fuel to provide 600 million Btu of boiler input daily:
   a. 300 million Btu from oil @ 140,000 Btu/gallon at purchase price of 32¢/gallon - $685
   b. 300 million Btu from gas @ 1,100 Btu/MCF at interruptible purchase price of $1.05/MCF - $286
   c. Daily cost of fuel: $685 + $286 - $971
   d. Annual fuel cost: $971 x 250 days $242,750
2. Alternative purchase of tie butts from railroad: 11,500 tons @ $6 per ton $ 69,000
3. Unloading, grinding, and handling costs: 11,500 tons @ $1.75 per ton $ 20,125
4. Tie fuel costs to treating plant burner: $69,000 + $20,125 $ 89,125
5. Cost of burning tie fuel in fluid bed incinerator @ $4.234 per ton $ 48,700
6. Total annual cost of using tie fuel: $89,125 + $48,700 $137,825
7. Annual savings from using tie fuel versus current 50-50 gas-oil mixture: $242,750 - $137,825 $104,925

8.	Supplemental income from custom grinding of 64,500 tons of tie butts for railroad: 64,500 x 1.00 profit margin	$ 64,500
9.	Annual treating plant income from use and custom processing of tie butts (before interest and taxes): $104,925 + $64,500	[$169,425]
10.	Return on investment of $850,000	20 Percent

SUMMARY

The use of old crossties for fuel can be a financially attractive venture for both railroads and treating plants. True, railroads cannot make a profit by selling or using old ties for fuel unless they set the price above the level that treating plants can afford to pay. But railroads can reduce losses from current tie disposal practices. We estimate the net savings would be about $14 per ton or about $1.30 per tie.

Treating plants can expect to make a net profit from burning old ties for fuel. Plant operators treating 800,000 ties annually can expect an annual net income of about $170,000 (before taxes) if they shift from current 50-50 gas-oil mixtures to hogged tie fuel. Each ton of tie fuel burned permits a savings of about $9 compared to present fuels. Of course, some additional treating plant income accrues from the resale of hogged fuel to the railroads or other industrial consumers.

Why not investigate this promising venture? You could probably make money and also conserve some of the Nation's vital fuel resources.

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